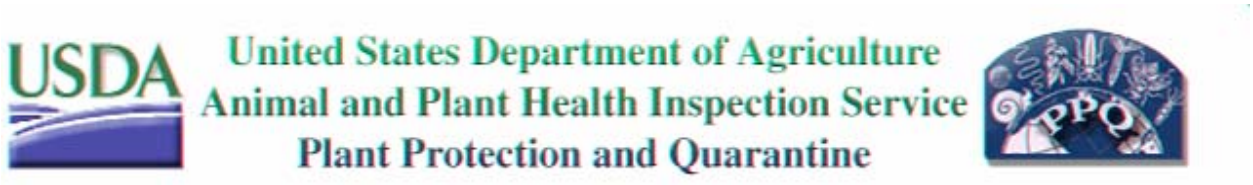

Importation of Christmas Cactus, *Schlumbergera* spp. and Easter Cactus, *Rhipsalidopsis* spp., In APHIS Approved Growing Media, Into the United States, From Denmark

Gary L. Cave, Ph.D., Entomologist
Eileen Sutker, Ph.D., Ecologist

United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine
Center for Plant Health Science and Technology
Plant Epidemiology and Risk Analysis Laboratory
Raleigh, NC 27606

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Executive Summary

This pathway-initiated commodity risk analysis examines the risks associated with the proposed importation of Christmas and Easter cactus plants of *Schlumbergera* and *Rhipsalidopsis*, respectively, in APHIS-approved growing media, from Denmark into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines version 5.02 which examines pest biology in the context of the Consequences of Introduction and Likelihoods of Introduction and estimates the Pest Risk Potential. There are no quarantine pests, *sensu* FAO (2003) that can follow the pathway on these plants. All imported propagative materials, however, must meet the requirements specified in 7 CFR § 319.37.

The accompanying pest risk management section of this document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR § 319.37-8) and proposed additional mitigation measures are applied to the importation of *Schlumbergera* and *Rhipsalidopsis* plants in growing media from Denmark. The use of the mitigation measures cited in the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR § 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products)
is expected to substantially reduce the Likelihood of Introduction, and as such, the overall pest risk potential would be rated low because the known pests effectively are removed the from the pathway.

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I. Introduction

This pest risk analysis (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation from Denmark, of Christmas Cactus (*Schlumbergera* spp.) and Easter Cactus (*Rhipsalidopsis* spp.) plants established in an APHIS-approved growing medium into the United States.

The methods used to initiate, conduct, and report this pest risk analysis and the use of biological and phytosanitary terms are consistent with international guidelines (FAO, 2002, 2003). The rating criteria used to categorize the potential biological severity of the impacts caused by exotic plant pests are found in the document: Pathway-Initiated Pest Risk Assessment: Guidelines for Qualitative Assessments, version.5.02 (USDA, 2000).

The authority for APHIS to regulate plant pests and plant products is derived from the Plant Protection Act of 2000 (7 USC §§ 7701 *et seq*.) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR § 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology and rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2002, 2003) and current agency guidelines (USDA, 2000).

II. Risk Assessment

A. Initiating Event: Proposed Action

This commodity-based, pathway-initiated pest risk analysis was prepared in response to a request from the Government of Denmark to change current regulations to allow the importations of Christmas Cactus (*Schlumbergera* spp.) and Easter Cactus (*Rhipsalidopsis* spp.) plants established in seedling trays, in APHIS-approved growing media or as bare-root plants with small amounts of APHIS-approved growing media attached to the rootlets. This is a potential pathway for the introduction of plant pests. These plants are currently permitted entry into the United States as bare-root plants (free of media or without any attached growing media) and are regulated under 7 CFR § 319.37.

Several European countries are currently exporting bare-root Cactaceae plants into the United States. In 1994, agricultural representatives of Belgium, Denmark, Israel and the Netherlands requested permission to export *Schlumbergera* spp. established in growing media to the United States. Currently, the importation of bare-root or unrooted cuttings of Cactaceae plants into the United States is subject to inspection and treatment, if warranted, at specially equipped inspection stations as denoted in 7 CFR § 319.37-14. Importations must also be in accordance with the Convention on International Trade in Endangered Species (CITES, 1998).

The USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, biological contaminants may not be discernible during pre-shipment and Port of Entry visual inspections. The inability to non-destructively inspect all parts of the plants (particularly roots) is likely to increase the potential for the introduction of exotic organisms. Treatment of growing media may not rid the media of organisms in the absence of specific guidelines, and the possibility of pest infestation/re-infestation of clean plants in the absence of specific safeguards exists.

B. Assessment of Weed Potential of *Schlumbergera and Rhipsalidopsis* spp.

The determination of the potential weed threat posed by *Schlumbergera* and *Rhipsalidopsis* spp. or the existence of a previous characterization of these genera as weeds is documented in Table 1. The results of this weed screening for *Schlumbergera* and *Rhipsalidopsis* spp. did not prompt a pest-initiated risk assessment.

Table 1. Assessment of Weed Potential of *Schlumbergera* and *Rhipsalidopsis*

Commodities: *Schlumbergera* Lemaire (Cactaceae), - Christmas cactus, Thanksgiving Cactus, Crab Cactus, Yoke Cactus and Claw Cactus (synonyms: *Epiphyllanthus* and *Zygocactus*); *Rhipsalidopsis gaertneri* (Regel) Moran - Easter Cactus (synonyms: *Hatiora*, *Epiphyllum* and *Schlumbergera*)

Phase 1: Consider whether the genus is new to or not widely prevalent in the United States (exclude plants grown under USDA permit in approved containment facilities): The genus *Schlumbergera* and *Rhipsalidopsis* consisting of epiphytic cacti native to Brazil, and are cultivated in the United States in interiorscapes, under glass and as houseplants. In the southern US, plants may be placed outdoors in planters or used in the landscape.

Phase 2: Is the species listed in:

No Geographical Atlas of World Weeds (Holm *et al.*, 1979)
No World's Worst Weeds (Holm *et al*., 1977) or World Weeds: Natural Histories and Distribution (Holm *et al*, 1997)
No Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
No Economically Important Foreign Weeds (Reed, 1977)
No Weed Science Society of America list (WSSA, 1989)
No Is there any literature reference indicating weediness, *e.g.*, AGRICOLA, CAB, Biological Abstracts, AGRIS

Phase 3: Conclusion:

IF: 1. The species is widely prevalent in the United States and the answers to all of the questions are no - Proceed with the pest risk assessment.

C. Prior Risk Assessments, Current Status and Pest Interceptions

There are no interceptions of quarantine pests on *Schlumbergera* spp. or *Rhipsalidopsis* spp. imported into the United States from Denmark.

D. Pest Categorization

There are two components to the definition of quarantine pest (FAO, 2002). First, a pest must be "of potential economic importance", and, second, it must satisfy the geographic and regulatory criteria of ". . . not yet present there, or present but not widely distributed and being officially controlled." Both quarantine and non-quarantine pests for the United States are enumerated in the following comprehensive list (Table 2). If none of the pests satisfy the criteria for classification as a quarantine pest, the risk assessment may stop (FAO, 2003).

Quarantine pests not expected to follow the pathway were not considered further. Information supporting the non-quarantine pest status is documented in the pest list or in the text. The decision not to analyze particular pests applies only to the current assessment. Pests may pose a different level of risk for the same commodity from a different country or from a different commodity from the same host plant genus. For example, their primary association may be with plant parts other than the commodity; their primary association was with the commodity, but it was not considered reasonable to expect these pests to remain with the commodity during processing; they were intercepted as biological contaminants of these commodities, during inspection by Plant Protection and Quarantine Officers and would not be expected to be present with every shipment.

A pest list for *Schlumbergera* and *Rhipsalidopsis* spp. is presented (Table 2). This list is not comprehensive for all pests of *Schlumbergera* and *Rhipsalidopsis* for all countries in Europe. The purpose is to identify potential pests which may move into Denmark from other European countries on *Schlumbergera* and *Rhipsalidopsis* plants moving under the European Community Plant Passport System. The information in the Table includes the: scientific name of the pests, geographic distribution with respect to the exporting country and the United States, pest-host and pest-pathway associations, regulatory status of the pests, as determined by APHIS or other Federal Agencies, regulatory history, *i.e.,* interception records at U. S. ports-of-entry and selected references describing the biology of the pests.

Table 2: Pests of species of *Schlumbergera* and *Rhipsalidopsis*					
Pest	Geographic Distribution[1]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
ARTHROPODA					
ACARI					
Tetranychidae					
Tetranychus urticae Koch	EU, US	cladophyll	No	Yes	Baker and Tuttle, 1994; Tuinbowu-Akkerbouw, 1979
INSECTA					
HOMOPTERA					
Pseudococcidae					
Pseudococcus obscurus Essig	EU, US	cladophyll	No	Yes	McKenzie, 1967
Rhizoecus cacticans (Hambleton)	EU, US	Roots	No	Yes	Scalenet, 1998
BACTERIA					
Erwinia carotovora (Jones) Bergey *et al.* (Gracilicutes; Enterobacteriaceae)	EU, US	cladophyll	No	Yes	Bradbury, 1986; Chase, 1987; Denmark, 2000; EPPO, 1994; Poole *et al.*, 1998
FUNGI					
Bipolaris cactivora (Petr.) Alcorn (Fungi Imperfecti: Hyphomycetes)	EU, US	cladophyll	No	Yes	ARS, 1998; Chase, 1987; Chase and Conover, 1998; CMI, 1990; Farr *et al.*, 1989; Goodey *et al.*, 1965
Fusarium monililforme J. Sheld. (Fungi Imperfecti: Hyphomycetes)	EU, US	cladophyll	No	Yes	Farr *et al.*, 1989
Fusarium oxysporum Schlechtend. (Fungi Imperfecti: Hyphomycetes)	EU, US	cladophyll	No	Yes	Denmark, 2000; Farr *et al.*, 1989
Fusarium oxysporum Schlechtend. f.sp. *opuntiarum* (Pettinari) Gordon (Fungi Imperfecti: Hyphomycetes)	DE, NL	cladophyll	Yes	No[2]	ARS, 1998; CABI, 1966; Miller, 1980; Moorman, 1998; O'Donnell, 2001; Poole *et al.*, 1998

Table 2: Pests of species of *Schlumbergera* and *Rhipsalidopsis*					
Pest	Geographic Distribution[1]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Phytophythora nicotianae Breda de Haan. var. *parasitica* (Dastur) G. M. Waterhouse (Oomycetes: Peronosporales)	EU, US	cladophyll roots	No	Yes	Alfieri and Miller, 1977; Chase, 1997; Farr *et al*., 1989; Moorman, 1998
Pythium aphanidermatum (Edson) Fitzp. (Oomycetes: Peronosporales)	EU, US	cladophyll roots	No	Yes	ARS, 1998; Chase, 1987; CMI, 1978; Farr *et al.*, 1989
Pythium irregulare Buisman (Oomycetes: Peronosporales)	EU, US	cladophyll roots	No	Yes	ARS, 1998; Chase, 1997; CMI, 1986; Farr *et al*., 1989; Moorman, 1998
Rhizoctonia solani Kühn (Fungi imperfecti: Agonomycetes)	EU, US	roots, stems	No	Yes	ARS, 1998; Farr *et al.*, 1989
NEMATODA					
Heteroderidae					
Cactodera cacti (Filipjev & Schuurmans Stekhoven) Krall & Krall	EU, US	Roots	No	Yes	Chase, 1987; Evans *et al*., 1993; Goodey *et al*., 1965; Poole *et al*., 1998; Society of Nematologists, 1984
Meloidogyne arenaria Chitwood	EU, US	Roots	No	Yes	Evans *et al*., 1993; Society of Nematologists, 1984; Taylor and Sasser, 1978
Meloidogyne incognita Chitwood	EU, US	Roots	No	Yes	Evans *et al.*, 1993; Society of Nematologists, 1984; Taylor and Sasser, 1978
Tylenchulidae					
Pratylenchus vulnus Allen & Jensen	EU, US	Roots	No	Yes	Goody *et al.*, 1965; Luc *et al.*, 1990; Society of Nematologists, 1984
VIRUSES					
Cactus virus X =Zygocactus virus X (Potexvirus)	EU, US	Systemic	No	Yes	Brunt *et al.*, 1996; Chase, 1987

Table 2: Pests of species of *Schlumbergera* and *Rhipsalidopsis*					
Pest	Geographic Distribution[1]	Plant Part Affected	Quarantine Pest	Follow Pathway	References
Impatiens necrotic spot virus = Tomato Spotted Wilt Virus-Impatiens strain (Bunyaviridae: Tospovirus)	EU, US	Systemic	No	Yes	Moorman, 1998; Tisserat, 1995

[1]Distribution: DE-Germany, EU-Europe, NL-Netherlands, US-United States.
[2]This pathogen is not present in Denmark (Denmark, 2000; Kerry O'Donnell, USDA, ARS, personal communication).

There are no pests listed in Table 2 that meet the FAO criteria for classification as quarantine pests. Although this is a valid reason to stop the analysis (FAO, 2003), there are issues that need to be addressed. These are the risk associated with fungi in the genus *Fusarium*, and the importation requirements for plants in growing media.

The organism *Fusarium oxysporum* occurs in the United States and Europe and is regularly controlled in greenhouse production systems (Alfieri and Miller, 1977). Current taxonomic classifications of *Fusarium oxysporum* recognize a number of *formae speciales* based on host range testing (Agrios, 1997; Baayen, *et al*., 2000; Daughtrey *et al*., 1995; Gerlach, 1972). The *formae speciales* identified in Germany and the Netherlands, as *opuntiarum*, is not known to be present in the United States or Denmark (O'Donnell, personal communication), and was distinguished primarily on molecular techniques (Baayen, *et al*., 2000; Gerlach, 1972). Based on this, *F. oxysporum* f. sp. *opuntiarum* may be considered a quarantine pest (from the countries where it occurs) until the presence of this organism, at that level of taxonomic specificity, is verified to occur in the United States. However, in the United States diagnoses in production systems are not made at the *formae speciales* level (Chase 2001; Daughtrey *et al*., 1995; Miller, 1980; Moorman, 1998). The characteristic above-ground symptoms of cladophyll rot are relatively easy to identify and treat in the greenhouse (Agrios, 1997; Chase, 1987, 2001; Miller, 1980; Moorman, 1998) and the use of clean stock and phytosanitary greenhouse production programs provides effective control for *Fusarium* diseases (Chase, 2001). For these reasons, *Fusarium oxysporum* f.sp. *opuntiarum* is not analyzed as a unique quarantine pest for the purposes of this document.

Several species of *Opuntia* are listed as threatened or endangered species in the United States (Title 50, Part 17 (50 CFR §17)) and it is unknown if the *F. oxysporum* f. sp. *opuntarium* found in Europe can infect Threatened, Endangered or Candidate plant populations (O'Donnell, personal communication). *Fusarium* spp. can survive as dormant spores, which may remain undetected on the host plants (Agrios, 1997; Daughtrey *et al*., 1995), whether bare-root or in growing media. For these reasons, importation of species of *Schlumbergera* in growing media into the United States must meet the regulations that apply to plants in growing media (7 CFR §319.37-8). The use of these mitigation measures is expected to substantially reduce the Likelihood of Introduction, and as such, the overall pest risk potential would be rated low

because the known pests effectively are removed the from the pathway. Additionally, *Schlumbergera* must be artificially propagated and cannot be collected from the wild in accordance with the CITES regulations (CITES, 1998).

III. Phytosanitary Measures/Risk Management

There are special concerns associated with non-destructive inspections of propagative material established in growing media. For example, the presence of biological contaminants may not be discernable by visual inspection (this includes both pre-departure and port-of-entry inspections); the efficacy of treatment(s) of the growing media may not be discernable; pest infestation and/or reinfestation of "clean" plants may be undetected. The risks of importing propagative materials in growing media have been addressed by the USDA (Santacroce, 1991) and mitigated in regulations outlined in 7 CFR § 319.37-8.

In contrast, the characteristic above ground symptoms of cladophyll rot due to infection by *Fusarium* species are relatively easy to identify and treat (Agrios, 1997; Chase, 1987, 2001; Miller, 1980; Moorman, 1998). *Fusarium oxysporum* occurs in the United States and Europe and is regularly controlled in greenhouse production systems (Alfieri and Miller, 1977). The control measures used in the United States for *Fusarium* generally do not rely on diagnoses confirmed at the *formae speciales* level (Chase, 2001; Daughtrey *et al*., 1995; Miller, 1980; Moorman, 1998). In practice, diagnostic confirmation of the presence or absence of *Fusarium oxysporum* f.sp. *opuntarium*, when a clean stock and greenhouse production program is in use, should not be necessary because effective mitigation measures control many *Fusarium* diseases (Chase, 2001).

The proposed importation of *Schlumbergera* and *Rhipsalidopsis* plants in APHIS-approved growing media and under greenhouse growing conditions, if approved, will be managed by existing regulations [7 CFR § 319.37-8]. The mitigation measures described comprise a "Systems Approach" designed to establish and maintain a pest-free production environment. The Plant Protection Act of 2000 (7 USC §§ 7701 *et seq*.) defines a "Systems Approach" as "…a defined set of phytosanitary procedures, at least two of which have an independent effect in mitigating pest risk associated with the movement of commodities." 7 USC § 7702. The FAO Standard for Integrated Measures for Pest Risk Management definition of a Systems Approach is, "The integration of different pest risk management measures, at least two of which act independently, and which cumulatively achieve the desired level of phytosanitary protection." (FAO, 2002). Pest risk management is one of the components (analysis, management, and communication) of the decision-making process of reducing the risk of introduction of a quarantine pest (FAO, 2002). These mitigations effectively remove the pests from the pathway prior to importation into the United States.

Systems Approaches are established by an importing country as an alternative to the use of single quarantine measures when a single phytosanitary measure is nonexistent, not feasible or undesirable. The combinations of specific mitigation measures that provide overlapping or sequential safeguards are distinctly different from single mitigation methodologies such as fumigation or inspection (Jang and Moffitt, 1994). Systems Approaches vary in complexity and are often tailored to specific commodity-pest-origin combinations (FAO, 2002). Options for specific measures may be selected from a range of pre-harvest and post-harvest measures, *e.g*., surveys, inspections, sanitation, chemical treatments, *etc*; and include mitigation measures to

compensate for uncertainty. PPQ uses systems approaches for the importation of many commodities including Unshu oranges from Japan (7 CFR § 319.28), tomatoes from Spain, France, Morocco, and Western Sahara (7 CFR § 319.56-2dd), peppers from Israel, and ferns from The Netherlands (7 CFR § 319.56-2u). These programs have performed successfully for many years as evidenced by the very low numbers of interceptions over the years the programs have been active.

The three main categories of mitigation measures specifically required by 7 CFR § 319.37-8 (e) for propagative materials are: use of pest-free propagative material, pest-exclusionary greenhouses and inspection. Ensuring pest-free propagative material requires monitoring and testing of mother stock and descendant plants (Agrios, 1997; Jarvis, 1992; Kahn, 1977) and the use of pest-free mother stock plants. The terms "stock plants" and "mother blocks" are used interchangeably when referring to plants which are grown in APHIS-approved media.

The use of clean mother stock is an essential component of ornamental plant production (Agrios, 1997; Bodman *et al*., 1996; Jarvis, 1992; Jones and Benson, 2001; Metcalf and Metcalf, 1993; Mizell and Short, 1999). This requirement initially excludes pests from the plant production environment (Kahn and Mathur, 1999; Metcalf and Metcalf, 1993). Fungal pathogens introduced into the greenhouse via infested plant material can also be reduced or eliminated by clean mother stock (Jones and Benson, 2001).

Pest-exclusionary greenhouses employ treatments, good sanitation, *e.g.*, surface disinfection of tools and plant materials, *etc*. (Agrios, 1997; Barry, 1996; Bessin, 2001; Jarvis, 1992; Jones and Benson, 2001; Kahn and Mathur, 1999), clean water sources (Bodman *et al*., 1996; Jarvis, 1992; Kahn and Mathur, 1999; Pirone, 1978; Van der Plank, 1963), and use of approved growing media. Sanitation is the general cleanliness and pathogen-free condition of the nursery operation, aimed at reducing the overall inoculum level in the nursery (Jones and Benson, 2001). Surface disinfection may be achieved with isopropyl alcohol, denatured ethyl alcohol, sodium hypochlorite, and calcium hypochlorite. Surface disinfection of bare roots is achieved by dipping in a solution of *n*-alkyl ammonium chloride prior to propagation. These solutions are most effective if used within 30 minutes of preparation (Jones and Benson, 2001). Studies on APHIS-approved growing media found that pathogens are not present (Santacroce, 1991). Approved growing media is defined in 7 CFR 319.37-8(e)(1) and 319.37-8(f)(3)(iv). Improper nursery practices (the primary means by which pathogens are introduced and spread in the nursery according to Jones and Benson, 2001) are avoided by oversight and quality assurance required by USDA APHIS and captured in an operational workplan.

Pest management of ornamentals often includes chemical pest control (Osborne, *et. al*., 2001). Chemical controls are supplemental and used in combination with other mitigation measures, such as pest exclusionary greenhouses (Reinert, 1981, Ghidiu and Roberts, 2003). Physical pest control measures are effective mitigations in greenhouses. Such measures include washing with a hose and water and spraying inert soap sprays for aphids; spraying with horticultural oils for mealybugs, scale insects, and whiteflies; and physical removal and destruction for leafminers.

Well-water is the preferred source for irrigation, since well water is generally pathogen-free, while pond water is a major source of water mold pathogens. If water must be recirculated, a bromine treatment will eradicate plant-pathogenic bacteria (Jones and Benson, 2001).

The United States import restrictions barring soil carried with propagative horticultural plants effectively prevent the introduction of many mollusks (Robinson, 2002). Screens and doors exclude the entry of flying or crawling pests that cannot fit through screens (Bessin, 2001; Metcalf and Metcalf, 1993). The greenhouse enclosure provides a physical barrier to plants' exposure to fungal spores that are rain splashed or windborne (Agrios, 1997; Pirone, 1978; Barry, 1996).

The mitigations detailed above emphasize the use of pest free sources of growing media and pest free commodity proper. There are then several mitigations aimed at ensuring that the pest free status is maintained throughout the production process and along the transportation pathway. A series of inspections are also incorporated to assure quality control and phytosanitary rigor.

While not specifically required under 7 CFR § 319.37-8(e), standard industry practices help to further ensure that the pests of concern do not follow the pathway. These include sanitation and chemical treatments designed to reduce or eliminate insects (Bessin, 2001; Mizell and Short, 1998) and fungi (Jones and Benson, 2001), and *in vitro* or aseptic vegetative propagation (Hartman and Kester, 1959). Other cultural practices, such as proper lighting, nutrition, sanitation, temperature and watering, enhance plant vigor so that pests are less able to infest or infect mother stock (Bodman *et al*., 1996; Jones and Benson, 2001; Kahn and Mathur, 1999).

Because of these potential biological hazards, mitigating factors for the importation of *Schlumbergera* and *Rhipsalidopsis* from Denmark must include those conditions specified in the U.S. Code of Federal Regulations (7 CFR § 319.37-8). Concomitantly, *Schlumbergera* must be artificially propagated and cannot be collected from the wild in accordance with CITES regulations (CITES, 1998). The use of these mitigation measures is expected to substantially reduce the Likelihood of Introduction, and as such, the overall pest risk potential would be rated low because the known pests effectively are removed the from the pathway.

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